

# इंटरनेट

# मानक

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Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 3444 (1999): Corrosion Resistant High Alloy Steel And Nickel Base Castings for General Applications [MTD 14: Foundry]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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भारतीय मानक

सामान्य अनुप्रयोगों के लिए संक्षारण प्रतिरोधी उच्च  
मिश्र – इस्पात तथा निक्कल आधारित ढलाइयाँ – विशिष्ट  
( तीसरा पुनरीक्षण )

*Indian Standard*

CORROSION RESISTANT HIGH ALLOY STEEL AND  
NICKEL BASE CASTINGS FOR GENERAL  
APPLICATIONS — SPECIFICATION  
( *Third Revision* )

ICS 77.140.20

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BUREAU OF INDIAN STANDARDS  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

## FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Castings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1966 and was subsequently revised in 1978 and 1987. In the present revision the following main modifications have been made:

- a) Various clauses have been aligned with the recent standards on Steel Castings;
- b) The list of referred standards is annexed;
- c) The definition on cast melt has been modified;
- d) Clause's on supply of material and non-destructive tests have been modified; and
- e) Clause, on particulars to be specified while ordering has been included in the main text of the standard.

Corrosion resistant steel castings are used in various industries such as chemicals dyes petroleum refining, pharmaceuticals, food processing, paper, sugar, etc, for services at normal atmospheric or elevated temperatures. The alloy combinations of these castings are chiefly iron-chromium, iron-chromium-nickel, nickel-molybdenum, nickel and nickel-copper type. For applications involving corrosion at elevated temperature, reference should be made to IS 7806:1993 'Martensitic and austenitic high alloy steel castings for high temperature service (*second revision*)'.

Typical applications are given in Annex C.

In formulating this standard, assistance has been derived from ASTM A : 743/A743M-93a 'Specification for corrosion resistant iron-chromium, iron-chromium-nickel and nickel base alloy castings for general application', issued by the American Society for Testing and Materials.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# CORROSION RESISTANT HIGH ALLOY STEEL AND NICKEL BASE CASTINGS FOR GENERAL APPLICATIONS — SPECIFICATION ( *Third Revision* )

**1 SCOPE**

This standard covers the requirements for high alloy steel and nickel base castings suitable for corrosion resistant applications.

**2 REFERENCES**

Indian Standards listed in Annex A are necessary adjuncts to this standard.

**3 TERMINOLOGY**

**3.1** For the purpose of this standard, the following definitions shall apply.

**3.1.1** *Cast (Melt)* — The product of any one of the following:

- a) One furnace heat,
- b) One crucible heat, or
- c) A number of furnaces or crucible heats of similar composition mixed in a ladle before pouring.

**3.1.2** *Batch* — A group of castings of one grade of material, cast from the same melt and heat treated together under identical conditions.

**4 GRADES**

This standard covers a total of 27 grades of corrosion resistant high castings (*see* Table 1).

**5 SUPPLY OF MATERIAL**

General requirements relating to supply of corrosion resistant high alloy steel and nickel base castings shall conform to IS 8800.

**6 MANUFACTURE**

The material for the castings shall be made by electric arc or electric induction or such other processes as may be agreed to between the purchaser and the manufacturer.

**7 PARTICULARS TO BE SPECIFIED WHILE ORDERING**

For the benefit of purchaser, particulars to be specified while ordering for the castings under this specification are given in Annex B

**8 CHEMICAL COMPOSITION**

**8.1** The ladle analysis of material, when carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical methods, shall be as given in Table 1. In case of dispute, the procedure given in IS 228 shall be the referee method. However, where the method is not given in IS 228 the referee method shall be agreed to between the purchaser and the manufacturer.

**8.2** The manufacturer shall carry out analysis from a sample of each melt and, if so specified by the purchaser at the time of enquiry and order, shall supply a test certificate of chemical analysis of sample of material for each melt.

**8.3 Product Analysis**

If specified at the time of enquiry and order, the product analysis may be carried out from a broken tensile test piece or from a casting representing each melt. Drillings for analysis shall be taken from not less than 6 mm beneath the cast surface, and in such a manner as not to impair the usefulness of any casting selected. The permissible variation in product analysis from the limits specified in Table 1 shall be as given in IS 6601.

**8.4 Residual Elements**

**8.4.1** Elements not specified in Table 1, need not ordinarily be added to the steel and all reasonable precautions shall be taken to prevent contamination from scrap, etc, to keep them as low as practicable.

**8.4.2** Analysis and reporting of the analysis in test certificate for the residual elements shall be done only when so specified by the purchaser in enquiry and order. However, the manufacturer shall ensure that the residual elements are within the limits, when such limits are specified by the purchaser in enquiry and order.

**Table 1 Chemical Requirements**  
(Clauses 4, 8.1, 8.3 and 8.4.1)

Grade	Constituent, Percent <sup>1)</sup>														
(1)	C (2)	Si (3)	Mn (4)	P (5)	S (6)	Cr (7)	Mo (8)	Ni (9)	Nb (10)	Se (11)	Cu (12)	W (13)	V (14)	Co (15)	Fe (16)
1	0.08	2.00	1.50	0.04	0.04	18.0-21.0	—	8.0-11.0	—	—	—	—	—	—	Remainder
2	0.12	2.00	1.50	0.04	0.04	20.0-23.0	—	10.0-13.0	—	—	—	—	—	—	Remainder
3	0.20	2.00	1.50	0.04	0.04	18.0-21.0	—	8.0-11.0	—	—	—	—	—	—	Remainder
4	0.08	2.00	1.50	0.04	0.04	18.0-21.0	2.0-3.0	9.0-12.0	—	—	—	—	—	—	Remainder
5	0.08	2.00	1.50	0.04	0.04	18.0-21.0	—	9.0-12.0	<sup>2)</sup>	—	—	—	—	—	Remainder
6 <sup>3)</sup>	0.16	2.00	1.50	0.17	0.04	18.0-21.0	1.5 Max	9.0-12.0	—	0.20-0.35	—	—	—	—	Remainder
6A <sup>3)</sup>	0.16	2.00	1.50	0.04	0.20-0.40	18.0-21.0	0.40-0.80	9.0-12.0	—	—	—	—	—	—	Remainder
7	0.20	2.00	1.50	0.04	0.04	22.0-26.0	—	12.0-15.0	—	—	—	—	—	—	Remainder
7A <sup>4)</sup>	0.10	2.00	1.50	0.04	0.04	22.0-26.0	—	12.0-15.0	—	—	—	—	—	—	Remainder
8	0.20	2.00	2.00	0.04	0.04	23.0-27.0	—	19.0-22.0	—	—	—	—	—	—	Remainder
9	0.30	2.00	1.50	0.04	0.04	26.0-30.0	—	8.0-11.0	—	—	—	—	—	—	Remainder
10	0.15	1.50	1.00	0.04	0.04	11.5-14.0	0.50 Max	1.0 Max	—	—	—	—	—	—	Remainder
11	0.15	0.65	1.00	0.04	0.04	11.5-14.0	0.15-1.0	1.0 Max	—	—	—	—	—	—	Remainder
12	0.30	1.50	1.00	0.04	0.04	18.0-21.0	—	2.0 Max	—	—	<sup>5)</sup>	—	—	—	Remainder
13	0.50	1.50	1.00	0.04	0.04	26.0-30.0	—	4.0 Max	—	—	—	—	—	—	Remainder
14	0.20-0.40	1.50	1.00	0.04	0.04	11.5-14.0	0.50 Max	1.0 Max	—	—	—	—	—	—	Remainder
15	0.03	2.00	1.50	0.04	0.04	17.0-21.0	—	8.0-12.0	—	—	—	—	—	—	Remainder
16	0.03	1.50	1.50	0.04	0.04	17.0-21.0	2.0-3.0	9.0-13.0	—	—	—	—	—	—	Remainder
17	0.08	1.50	1.50	0.04	0.04	18.0-21.0	3.0-4.0	9.0-13.0	—	—	—	—	—	—	Remainder
18	0.07	1.50	1.50	0.04	0.04	19.0-22.0	2.0-3.0	27.5-30.5	—	—	3.0-4.0	—	—	—	Remainder
19	0.12	1.50	1.00	0.040	0.040	15.50-20.00	16.0-20.0	Remainder	—	—	—	5.25	0.40	2.50	7.50
20	0.40	3.00	1.50	0.030	0.030	14.00-17.00	—	Remainder	—	—	—	—	—	—	11.00
21	1.00	2.00	1.50	0.030	0.030	—	—	Remainder	—	—	1.25 Max	—	—	—	3.00
22	0.35	2.00	1.50	0.030	0.030	—	—	Remainder	—	—	26.0-33.0	—	—	—	3.50
22A	0.35	1.25	1.50	0.030	0.030	—	—	Remainder	—	—	26.0-33.0	—	—	—	3.50
23	0.12	1.00	1.00	0.040	0.030	1.00 Max	26.0-33.0	Remainder	—	—	—	—	0.60	2.50	6.00
24	0.06	1.00	1.00	0.040	0.03	11.5-14.0	0.40-1.0	3.5-4.5	—	—	—	—	—	—	—

<sup>1)</sup> The value of constituents percentage should be treated as maximum wherever a range is not specified.

<sup>2)</sup> Grade 5 shall have a niobium content of not less than 8 times the carbon content and not more than 1.0 percent. If a niobium plus tantalum alloy in the approximate Nb: Ta ratio of 3 : 1 is used for stabilizing this grade, the total niobium plus tantalum content shall not be less than 9 times the carbon content and shall not exceed 1.1 percent.

<sup>3)</sup> Grades 6 and 6A are for free machining steels.

<sup>4)</sup> Grade 7A is with limited carbon for more severely corrosive to condition.

<sup>5)</sup> For Grade 12, copper content of 0.90 to 1.20 percent is optional.

## 9 WORKMANSHIP AND FINISH

9.1 The castings shall be accurately moulded in accordance with the pattern or working drawings supplied by the purchaser or as mutually agreed, with the addition of such letters, figures and marks as may be specified.

9.2 The purchaser shall specify tolerances on all important dimensions. On other dimensions tolerances specified in IS 4897 shall apply.

## 10 FREEDOM FROM DEFECTS

10.1 All castings shall be free from defects that will adversely affect machining and utility of castings.

10.2 When necessary to remove risers or gates by flame or electric arc or a combination thereof, or by any other process involving intense heat, care shall be taken to make the cut at a sufficient distance from the body of the casting so as to prevent any defect being introduced into the casting due to local heating. Any such operation is preferably done before heat treatment.

10.3 In the event of any casting proving defective from foundry causes in the course of preparation, machining or erection, such casting may be rejected notwithstanding any previous certification of satisfactory testing and/or inspection.

## 11 FETTLING AND DRESSING

All castings shall be properly fettled and dressed, and all surfaces shall be thoroughly cleaned.

## 12 HEAT TREATMENT

**12.1** Castings shall be heat treated in a properly constructed furnace, having adequate means of temperature control, which shall permit the whole of the castings to be uniformly heated to the necessary temperature. All castings shall be suitably heat treated as specified in Table 2 so as to attain specified mechanical properties.

**12.2** The test pieces shall be heat treated along with the castings they represent.

**Table 2 Heat Treatment Requirements**  
(Clause 12.1)

Grade	Heat Treatment
1, 2, 3, 4, 5, 6, 6A and 17	Heat to 1 040°C, <i>Min</i> , hold for sufficient time to ensure temperature equalisation throughout the casting, quench in water or rapid cool by other means so as to develop acceptable corrosion resistance.
7, 7A, 8 and 9	Heat to 1 090°C, <i>Min</i> , hold for sufficient time to ensure temperature equalisation throughout the casting, quench in water or rapid cool by other means so as to develop acceptable corrosion resistance.
10, 11 and 14	a) Heat to 950°C, <i>Min</i> , furnace cool and temper at 590°C, <i>Min</i> , or; b) Heat to 790°C, <i>Min</i> , and furnace cool.
12 and 13	a) Heat to 790°C, <i>Min</i> , and air cool; or b) Heat to 790°C, <i>Min</i> , and furnace cool.
15 and 16	a) Heat to 1 040°C, <i>Min</i> , hold for sufficient time to ensure temperature equalisation throughout the casting, and cool rapidly so as to develop acceptable corrosion resistance; or b) As cast if corrosion resistance is acceptable.
18	Heat to 1 120°C, <i>Min</i> , hold for sufficient time to ensure temperature equalisation throughout the casting, quench in water or rapid cool by other means so as to develop acceptable corrosion resistance.
20, 21, 22 and 22A	As cast
19 and 23	As agreed upon by the purchaser and the manufacturer so as to develop acceptable corrosion resistance
24	Heat to 955°C, <i>Min</i> , air cool to below 95°C and temper between 565 to 620°C.

## 13 MECHANICAL TESTS

**13.1** The mechanical properties specified are those which are to be obtained from test bars cast either separately from or attached to the castings to which they refer and heat treated as given in 12. The test values so exhibited, therefore, represent the quality of steel from which the castings have been poured;

they do not necessarily represent the properties of the castings themselves.

### 13.2 Tensile Test

The tensile test shall be carried out in accordance with IS 1608. The relevant mechanical properties shall be as given in Table 3.

### 13.3 Hardness Test

Unless otherwise specified in enquiry and order, Grades 10, 11, 12 and 13 shall have a Brinell Hardness of 241 HB *Max*, Grade 14, 269 HB *Max* and Grade 24, 285 HB *Max* when tested in accordance with IS 1500.

**Table 3 Mechanical Properties**  
(Clause 13.2)

Grade	Tensile Strength <i>Min</i> , MPa	Yield Stress <i>Min</i> , MPa	Elongation Percent <i>Min</i>	Reduction of Area Percent <i>Min</i>
(1)	(2)	(3)	(4)	(5)
1 <sup>1)</sup>	485	205	32	—
2	480	190	32	—
3	480	210	27	—
4	480	210	27	—
5	480	210	27	—
6 & 6A	480	210	23	—
7 & 7A	480	210	27	—
8	450	190	27	—
9	550	280	09	—
10 & 11	620	450	16	30
12	450	210	—	—
13	380	—	—	—
14	690	480	13	25
15	485	205	32	—
16	480	210	27	—
17	520	240	23	—
18	430	170	32	—
19	500	320	3	—
20	480	190	27	—
21	350	120	9	—
22	450	210	23	—
22A	450	170	23	—
23	500	320	6	—
24	760	550	13	35

<sup>1)</sup> For low ferrite or non-magnetic castings of this grade, the following values shall apply:

T.S. = 450 MPa, *Min*

Y.S. = 195 MPa, *Min*

## 14 NON-DESTRUCTIVE TESTS

**14.1** Non-destructive testing shall be applied if so specified in enquiry and order. Under this heading are grouped the tests which aim at revealing defects which cannot be revealed by a simple visual examination, such as penetrant, magnetic particle,



ultrasonic, X-radiographic or gamma-radiographic inspection; also included under this heading are tests on the surface condition by visual or visual-tactile examination. The purchaser shall specify in enquiry and order:

- a) The type of non-destructive testing which he intends to carry out or to have carried out;
- b) The area or areas of the casting to which these tests apply, and the types of discontinuity;
- c) Whether all, or what proportion, of the castings are to be tested;
- d) The severity level defining the acceptability or non-acceptability of defect which may be revealed; and
- e) Whether the manufacturer is or is not contractually responsible for carrying out the tests.

**14.2** Unless otherwise agreed upon, when non-destructive testing is to be done the castings shall be examined as follows:

- a) Ultrasonic examination (*see* IS 7666);
- b) Magnetic particle examination (*see* IS 3703);
- c) Liquid penetrant examination (*see* IS 3658); and
- d) Radiographic examination (*see* IS 2595).

**14.3** Unless otherwise agreed upon the following shall be the acceptance standards:

- a) IS 9565 For ultrasonic inspection.
- b) IS 10724 For magnetic particle inspection.
- c) IS 11732 For liquid penetrant inspection.
- d) IS 12938 For radiographic inspection.

#### NOTES

1 In case of nickel base alloys in Table 1, the method of ultrasonic examination shall be as agreed to between the purchaser and the manufacturer.

2 In case of austenitic grades, ultrasonic examination and magnetic particle examination may not ordinarily be feasible.

#### 14.4 Microstructure

In case of austenitic steel castings, if required by the purchaser, the maximum permissible percentage of ferrite in the microstructure may be stipulated at the time of enquiry and order.

NOTE — The sample for metallographic examination shall be taken from the relevant test block. If the purchaser desires this test to be carried out on an agreed portion of the casting or an extension thereof, it should be so stipulated at the time of enquiry and order.

**14.4.1** The austenitic steel castings to Grades 1 to 9 and Grades 15 to 18 may either be fully non-magnetic or feebly magnetic depending on actual composition balance within the specified range.

**14.4.1.1** If required by the purchaser, the permissible degree of magnetism shall be subject of agreement at the time of enquiry and order.

#### 14.5 Supplementary Tests

**14.5.1** If specified at the time of enquiry and order, the following supplementary tests may be carried out:

- a) Inter-granular corrosion test, and
- b) Surface carbon analysis.

**14.5.2** The methods of testing and acceptance standards shall be as agreed to between the manufacturer and the purchaser. However, for austenitic stainless steels, inter-granular corrosion test shall be carried out in accordance with IS 10461 (Part 1) and IS 10461 (Part 2).

#### 15 REPAIR OF CASTINGS BY WELDING

**15.1** Unless otherwise specified by the purchaser in enquiry and order, castings may be rectified by welding. All repairs by welding shall be carried out in accordance with the procedure laid down in IS 5530 to the extent relevant. If castings have been subjected to non-destructive testing or hydraulic testing by agreement between the purchaser and the manufacturer, the castings shall be re-examined in the area of repair following any rectifying operation performed on the castings.

**15.2** To form the basis of an agreement between the purchaser and the supplier where relevant, the following classification shall apply concerning the extent of repair:

- a) Weld repair involving a depth not exceeding 20 percent of the wall thickness or 25 mm, whichever is lower, shall be termed as a minor repair.
- b) Any weld repair exceeding the above shall be termed as a major repair. Further, any single repair having an area exceeding 250 mm<sup>2</sup> for every millimetre of wall thickness shall also be deemed to be a major repair, regardless of the considerations mentioned in (a) above.

#### 16 METHOD OF SAMPLING

**16.1** The method of sampling castings for the purpose of chemical analysis and mechanical tests including retest shall be in accordance with IS 6907.

#### 17 MARKING

**17.1** Each casting shall be legibly marked with the following as may be relevant. However, where linkage

and traceability are required the relevant marking shall be indelible:

- a) The number or identification mark by which it is possible to trace the melt and the heat treatment batch from which it was made,
- b) The manufacturer's initial or trade-mark, and
- c) Other identification marks in accordance with any agreement between the purchaser and the manufacturer.

NOTE — It is recommended that minimum of markings be used.

17.2 By agreement between the purchaser and the manufacturer, castings complying with the require-

ments of this standard shall, after inspection, be legibly and indelibly marked with an acceptance mark.

### 17.3 BIS Certification Marking

The castings may also be marked with the Standard Mark.

17.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

## ANNEX A

(Clause 2)

### LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
228	Methods for chemical analysis of steels (in various parts)	7806 : 1993	Martensitic and austenitic high alloy steel castings for high temperature service ( <i>second revision</i> )
1500 : 1983	Method for Brinell hardness test for metallic materials ( <i>second revision</i> )	7666 : 1988	Recommended procedure for ultrasonic examination of ferritic castings of carbon and low alloy steel ( <i>first revision</i> )
1608 : 1995	Mechanical testing of metals—Tensile testing ( <i>second revision</i> )	8800 : 1997	Technical delivery conditions for steel castings ( <i>second revision</i> )
2595 : 1978	Code of practice for radiographic testing ( <i>first revision</i> )	9565 : 1995	Acceptance standards for ultrasonic inspection of steel castings ( <i>first revision</i> )
3658 : 1981	Code of practice for liquid penetrant flaw detection ( <i>first revision</i> )	10461	Resistance to inter-granular corrosion of austenitic stainless steels—Method for determination :
3703 : 1980	Code of practice for magnetic particle flaw detection ( <i>second revision</i> )	(Part 1) : 1994	Corrosion test in nitric acid medium by measurement of loss in mass (Huey test) ( <i>first revision</i> )
4897 : 1994	Deviations for untoleranced dimensions and mass of steel castings ( <i>third revision</i> )	(Part 2) : 1994	Corrosion test in a sulphuric acid/copper sulphate medium in the presence of copper turnings (Mony-penny Strauss test)
5530 : 1987	Code of procedure for repair and rectification of steel castings by metal arc welding process ( <i>first revision</i> )	10724 : 1990	Acceptance standards for magnetic particle inspection of steel castings ( <i>first revision</i> )
6601 : 1987	Permissible deviations in chemical composition for product analysis of steel castings	11732 : 1995	Acceptance standards for dye penetrant inspection of steel castings ( <i>first revision</i> )
6907 : 1992	Steel castings—Methods of sampling ( <i>second revision</i> )	12938 : 1990	Acceptance standards for radiographic inspection of steel castings

**ANNEX B**

(Clause 7)

**INFORMATION TO BE SUPPLIED BY THE PURCHASER****B-1 BASIS FOR ORDER**

While placing an order for purchase of steel castings covered by this standard, purchaser should specify the following:

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>a) Material specification;</li> <li>b) Drawing or reference number of the pattern (if supplied by the purchaser), along with a copy of the drawing;</li> </ul> | <ul style="list-style-type: none"> <li>c) Tests required;</li> <li>d) Whether the castings are to be inspected and tested in the presence of the purchaser's representative;</li> <li>e) Condition of delivery;</li> <li>f) Any special requirements; and</li> <li>g) Tests reports, if required.</li> </ul> |
|---|--|

**ANNEX C**

(Foreword)

**TYPICAL APPLICATIONS OF VARIOUS GRADES OF CASTINGS**

<i>Grade</i>	<i>Applications</i>	<i>Grade</i>	<i>Applications</i>
1	General service, pumps, valves, etc, for chemical processing, oil refineries, textile, dyeing, food machinery, architectural trim, fuel jets, fuel valves, engine supports.	11	Seats and discs in valves in steam service and also for parts in turbines exposed to high velocity steam.
2	General service, pumps, valves, mixers, piping and fittings, etc.	12	Food processing, nitric acid and rayon manufacture, rabble blades in ore roasting furnace, nitrogen production, pumps, valves, impellers.
3	Similar to Grade 1, but for less severe service.	13	Nitrocellulose production, alkaline liquors, oxidizing acids, pumps for dilute sulphuric acid in mine water.
4	Pumps, valves, fittings, etc, in reducing acids, paper mill equipment, process industries, sea water service.	14	Valve trim, abrasion and erosion resistant applications.
5	Similar to Grade 1, but especially useful where parts cannot be heat treated after welding.	15	Similar to Grade 1, but also resistant to intergranular corrosion.
6 & 6A	Improved machinability — Useful in service similar to Grade 3 or Grade 4 where finished product requires extensive drilling or threading.	16	Similar to Grade 4, but also resistant to intergranular corrosion.
7 & 7A	Paper pulp service, digester fittings, pumps, impellers, strainers, valves, ornaments, fire wall fittings, hand rail fittings, grills.	17	Similar to Grade 4, but specially suitable where pitting corrosion is more severe.
8	Sulphite liquor, cold dilute sulphuric acid service, agitators, fittings.	18	Applications requiring resistance to hot sulphuric acid; pump impellers used in naval boiler feed pump.
9	Digester fittings, pumps, valves for sulphite pulp service.	19	Outstanding resistance to such highly corrosive chemicals as wet chlorine, strong hypochlorite solutions ferric chloride cupric chloride, etc, or in any of their applications or in handling of these chemicals.
10	Valves and valve trim, pump parts for power plant and oil refining equipment, sliding or wearing parts.		

<i>Grade</i>	<i>Applications</i>	<i>Grade</i>	<i>Applications</i>
20	Handling corrosive vapours above 400°C; mainly in dairy, chemical, aeronautical, nuclear, petroleum and food processing industries.		impellers, for pumping salt cooling water and in chemical pumps. Where weldability is a requirement, Grade 22A is preferred.
21	Handling caustic processes, where low iron and copper content in the equipment is important.	23	Resistance to corrosion by hot concentrated hydrochloric acid solutions and wet hydrogen chloride.
22 & 22A	Highly resistant to salt-water corrosion, erosion and abrasion and is used for	24	Good corrosion resistance and resistance to abrasion.

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